GRENNER CONCRETE USING AGRO-INDUSTRIAL WASTE AS A PARTIAL REPLACEMENT OF CEMENT

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Abstract

The utilization of industrial and agricultural waste produced by industrial processes has been the focus of waste reduction research for economic, environmental and technical reasons. Sugar – cane bagasses is a fibrous waste – product of the sugar refining industry, along with ethanol vapor. This waste product (sugar – cane Bagasses Ash) is already causing serious environmental pollution, which calls for urgent ways of handling the waste. Bagasse ash has mainly contains silica and aluminum ion. In this project, the Bagasse ash has been chemically and physically characterized, and partially replaced in the ratio of 0%, 5%, 10%, 15%, and 25% by weight of cement in concrete. Ordinary Portland cement was replaced by ground bagasse ash at different percentage ratios. The compressive strengths of different mortars with bagasses ash addition were also investigated. M30 concrete mixes with bagasse ash replacements of 0%, 5%, 10%, 15%, and 25% of the Ordinary Portland cement were prepared with water – cement ratio of 0.42 and cement content of 378 kg/m3 for the control mix. Wet concrete tests like slump cone test, as well as hardened concrete test like compressive strength, split tensile strength and flexural strength at the age of 7days, 28 days and 90 days were carried out. The test results indicated that up to 10% replacement of cement by bagasses ash results in better or similar concrete properties and further environmental and economic advantages can also be exploited by using bagasse ash as partial replacement material.

1 Introduction

Concreteistheworld'smostconsumedman-madematerial.Toproduce1tonofPortlandcement,1.5tonsofrawmaterialsareneeded.Thesematerialsincludegoodqualitylimestone and clay. Therefore, to manufacture 1.5 billion tons of cement annually, at least 2.3billion tons of raw materials are needed. Over 5-million BTU of energy is needed to produceone tone of cement. In the year 1914, India Cement Company Ltd started cement productioninPorbandarwithanoutputof10,000tonsand aproductionof1000 installed capacity.At thetimeofindependence1947,theinstalledcapacityofcementplantsinIndiawasapproximately 4.5 milliontonsandactualproductionaround3.2milliontonsperyear.Thepartialdeepcontrolin 1982 prompted various industrial houses to set a setup new cement plants in the country,capacitywasnearly30milliontons,whichhasnow,increasetonearly120milliontonsduringaperiodof20years.Thefulldecontroloncementindustryin1988furtherprovidedmomentumforthegrowth.

India is the second largestproducer of cementon the globe after China. In total, Indiamanufactures251.2MillionTonsofcementperyear.ThecementindustryinIndiahasreceiveda great impetus from a number of infrastructure projects taken up by the Government of Indialikeroadnetworksandhousingfacilities.WhiletheIndiancementindustryenjoysaphenomenalphas eofgrowth,expertsrevealthatitispoisedtowardsahighlyprosperousfutureover the very recent years. The annual demand for cement in India is consistently growing at8-10%. National Counsel for Applied Economic Research (NCAER) has estimated after anextensive study that the demand for cement in the country is expected to increase to 244.82million tons by 2012. At the same time, the demand will be at 311.37 million tones if theprojectionsofthe roadandhousingsegmentsaremetinreality

1.2 Sugar Cane Bagasses

Sugarcane is composed about 30% bagasse whereas the sugar recovered is about 10%, and thebagasse leaves about 8% bagasse ash (this figure depend upon the high-quality and type of the boiler,current boiler release lower amount of bagasse ash) as a waste. As the sugar production isincreased, the quantity of bagasse ash produced will also be huge and the disposal might be aproblem.

Sugarcane bagasse ash has currently been tested in a few components of the sector for its use as acement substitute material. The bagasse ash become found to enhance a few houses of thepaste, mortar and concrete which includes compressive electricity and water tightness in sure replacementpercentages andfineness. The higher silica contentin the bagasse ash wassuggestedtobethemaincausefortheseimprovements.Althoughthesilicatecontentmayvaryfrom ash to ash relying at the burning conditions and different residences of the uncooked materialsincluding the soil on which the sugarcane is grown, it's been mentioned that the silicateundergoes a pozzolanic response with the hydration products of the cement and outcomes in areductionofthefreelimeintheconcrete.

Frompreviousexperimentalworks,itwasfoundthatanoptimalamountof10p.Cofcementcanbereplacedwithbagasseash.Thisproject presentsadetailedstudyofhowcement replacedinconcrete plays.

The present observe changed into carried out on SCBA acquired by controlled combustion of sugarcanebagasse,whichwasprocuredfromtheSamalkotinEast Godavaridistrict.ThisstudyanalyzestheeffectofSCBAinconcretebypartiallyreplacementofcementattheratioof0%,five%,10%,15%, 20%, and 25% with the aid of weight. The experimental take alook at examinesthe compressive power,spilttensilestrengthandflexuralstrengthofconcrete.ThemainingredientsconsistofPortlandcement,SCBA,riversand,coarseaggregateandwater.Aftermixing,concretespecimenswerecastedandsubsequentlyalltest specimenswerecuredinwaterat7days,28daysand90days

.2.MATERIAL PROPERTIES

2.1 Cement

Ordinary Portland Cement (OPC) is the cement best suited to general concreting purposes. OPC 53 grade confirming with IS: 8112-2007 is used. The cement is kept in an airtight container and stored in the humidity controlled room to prevent cement from being exposed to moisture.

2.2 Aggregates:

Aggregates are the important constituents in concrete. They give body to theconcrete,reduceshrinkageandeffecteconomy.

Aggregatesoccupy70to80percentofvolumeofconcrete.Aggregatesareobtainedeithernaturallyorartificially.Aggregatescanbeclassifiedonthebasisofsizeasfineaggregate andcoarseaggregate.

2.2.1 Fine Aggregates (Sand)

The size of the fine aggregate is below 4.75mm.Fine aggregates can be naturalor manufactured. The grade must be throughout the work. The moisture content or absorptioncharacteristics must be closely monitored. The fine aggregate used is natural sand obtainedfromtheriverGodavariconformingtogradingzone-IIoftable3ofIS:10262-2009.The experiment was conducted as per IS:2386-1963andthe value is 3.08

2.2.2 Coarseaggregate:

ThematerialwhoseparticlesareofsizeareretainedonISsieveofsize4.75mmis termed as coarse aggregate and containing only so much finer material as is permitted forthe varioustypesdescribedinIS:383-1970isconsideredascoarse aggregate.Aggregatesshould beofuniformqualitywithrespect toshapeandgrading.Thesizeofcoarseaggregateddependsuponthenatureofthework.Thecoarseaggregateusedinthisexperimental investigation is 20mm and 10mm size, crushed and angularin shape. Theaggregatesarefreefromdustbeforeusedintheconcrete. The specific gravity of the coarse aggregate is 2.69

2.2.3Water

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acid, alkalis, salts, organic materials or other substances they may be deleterious to concrete portable water is used for mixing as well as curing of concrete as prescribed in IS: 456 – 2000.

2.2.4SugarcaneBagasseAsh

Thesugarcanebagasseashconsistsofapproximately50% ofcellulose,25%ofhemicelluloses and 25% of lignin. Each ton of sugarcane generates approximately 26% ofbagasse(atamoisturecontentof50%)and0.62%ofresidualash.Theresidueaftercombustionpresents a chemical composition dominates by silicon dioxide (SiO_2). In spite of being amaterial of hard degradation and that presents few nutrients, the ash is used on the farms as afertilizerinsugarcaneharvests.In thissugarcanebagasseashwascollectedduringtheoperation of boiler operating in the Nava Bharat Ventures Sugar Factory, located in theSamalkot,EastGodavariDistrict,AndhraPradesh. The specific gravity of the sugar cane bagasse ash is 2.20

3. EXPERIMENTAL PROGRAM

In this experimental program, the first step is selecting of the raw materials. Concrete is a composition of three raw materials. Cement, Fine aggregate and Coarse aggregate. These three raw materials play an important role in manufacturing of concrete. Number of conventional trails is prepared and the mix proportions for M30 grade are selected by changing different water Cement ratios and water content. By varying the properties and amount of these raw materials, the properties of concrete will change. The experimental program was planned to study and improve the properties of concrete. The experimental program was carried out on cubes, cylinders. The details of the materials used for these specimens and testing procedure incorporated in the test program are presented in the subsequent sections.

3.1 MIX DESIGN FOR M30 GRADE AS PER IS 10262:2009

Cement is replaced by 30% GGBS and sand is replaced by 50% M-sand, 10%, 20%, 30% 40% recycled plastic granules / 1%, 3%, 5%, 7% crumb rubber powder and these specimens were tested for compression, split tensile strengths&Flexural strength. The variations of compressive strength, split tensile strength are discussed in the result section. The concrete mix proportions were designed as per IS: 10262-2009 code for M30.

TheThe steps involved in the design of concrete mix as per IS: 10262-2009, IS: 456-2000.

1.2 STIPULATIONS FOR PROPORTIONING

a) Grade designation - M30
b) Type of cement - OPC 53 grade conforming to IS 8112
c) Maximum nominal size of aggregate - 20mm
d) Minimum cement content - 300 kg/m²
e) Maximum water-cement ratio - 0.50
f) Workability - 100 mm (slump)
g) Exposure condition - Moderate
h) Type of aggregate - Crushed angular aggregate

3.3. Test data for materials

a) Cement used - OPC 53 grade conforming to IS 8112
b) Specific gravity of cement - 3.10
c) Specific gravity of
1) Coarse aggregate - 2.69
2) Fine aggregate –3.08
3)BagasseAsh – 2.3
Mix Proportion values
M 30 = 1: 2.1: 3.27

3.4 Compressive Strength

Compressive strength or crushing strength is the main property observed in testing the cubes. The cubes of size 150 x 150 x 150mm were casted. After 24 hours, the specimens are removed from the moulds and subjected to curing for 28 days in portable water. After curing, the specimens are tested for compressive strength using compression testing machine of 2000 KN capacity (IS: 516 – 1959). Cubes are tested to calculate Compressive strength by applying gradual loading in Compression Testing Machine. The maximum load at failure occurs on the top of the machine. For M30 grade concrete, Atotalof54cubeswerecastforthefivemixes.i.e.,foreachmix9cubeswereprepared.Testing of the specimens was done at 7 days, 28 days and 90 days, at the rate of three cubesfor each mix on that particular day.The average value of the 3 specimens is reported as thestrengthatthatparticularage

Compressive strength = ultimate compressive load/cross sectional area
= P/A
= load/area N/mm2

3.5 Split Tensile Strength

Split tensile strength is the most important property of concrete. Concrete generally weak in tension. So to improve tensile behaviour of concrete, split tensile strength is important. The tensile strength of concrete is necessary to determine the load at which the concrete members may crack. It is also important in reducing formation of cracks in concrete. Cylinders are casted for calculating split tensile strength. The cylindrical specimens are also tested in universal testing machine. Here the

cylinder split into the two parts and reading observed on the top of the machine.
The split tensile strength has been calculated by the formula
Split tensile strength = 2P / πLD
P = failure load (applied load)
L = height of the cylinder specimen
D = diameter of mould
For M30 grade concrete, 54 Cylinders were prepared for partial replacement of cement by sugar cane bagasseash&sand and aggregate of age 7, 28,90 days.
The specimens 150 mm diameter and 300mm height casted were tested after 7,28,90 days of curing measured from the time water is added to the dry mix. The load was applied axially without shock till the specimen was crushed.

3.6 Flexuralstrengthtest:

In the flexural strength test theoretical maximum tensile stress reached at thebottomfibresofthetestbeamisknownasthemodulusofrupture.Whenconcreteissubjectedtobendingstress,compressiveaswellastensilestressesaredevelopedattopandbottomfibresrespectively.The strengthshownbytheconcreteagainstbendingisknownasflexuralstrength.The standardsizeofspecimenis100mm×100mm×500mwithaspanof600mm.The flexural strength of the specimen is expressed as the modulus of rupture '**fb**' which, if 'a'equalsthedistancebetweenthelineoffractureandthenearestsupportmeasuredonthecentrelineofthetensilesideofthespecimen,incm,iscalculatedtothenearest0.05Mpaasfollows

$$fb = \frac{PL}{bd^2}$$

4. RESULTS

Table.No: 4.1 90 Days average compressive strength results for M30 grade

S.NO	MIX ID	COMPRESSIVE STRENGTH (N/mm^2)		
		7 Days	28Days	90Days
1	NORMALMIX	29.13	36.18	37.93
2	SCBA5%	28.15	36.89	38.67
3	SCBA10%	27.26	37.52	39.85
4	SCBA15%	24.44	33.93	35.41
5	SCBA20%	21.93	30.07	31.56
6	SCBA25%	19.26	24.85	26.52

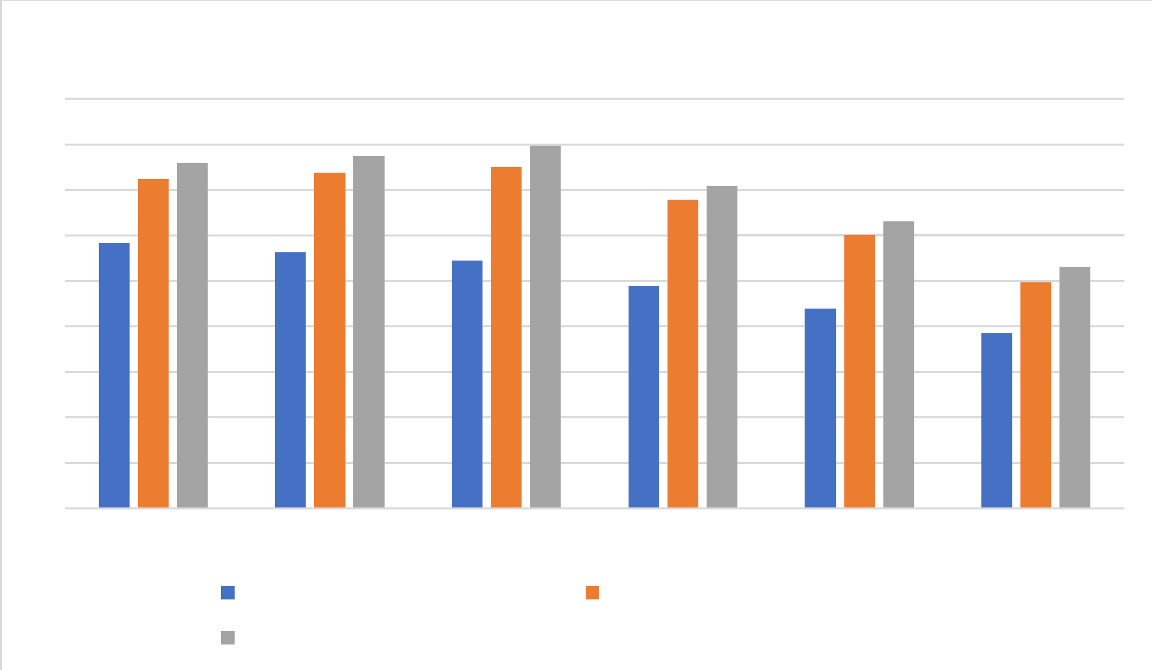

Fig No : 4.1 The compressive strength of the different days

Table.No: 4.2 90 Days average Split tensile strength results for M30 grade

S.NO	**MIX ID**	**Split Tensile Strength (N/mm^2)**		
		7 Days	**28Days**	**90Days**
1	NORMALMIX	1.89	2.55	2.64
2	SCBA5%	1.63	2.59	2.72
3	SCBA10%	1.60	2.75	2.83
4	SCBA15%	1.42	2.25	2.31
5	SCBA20%	1.17	1.92	2.03
6	SCBA25%	1.06	1.76	1.83

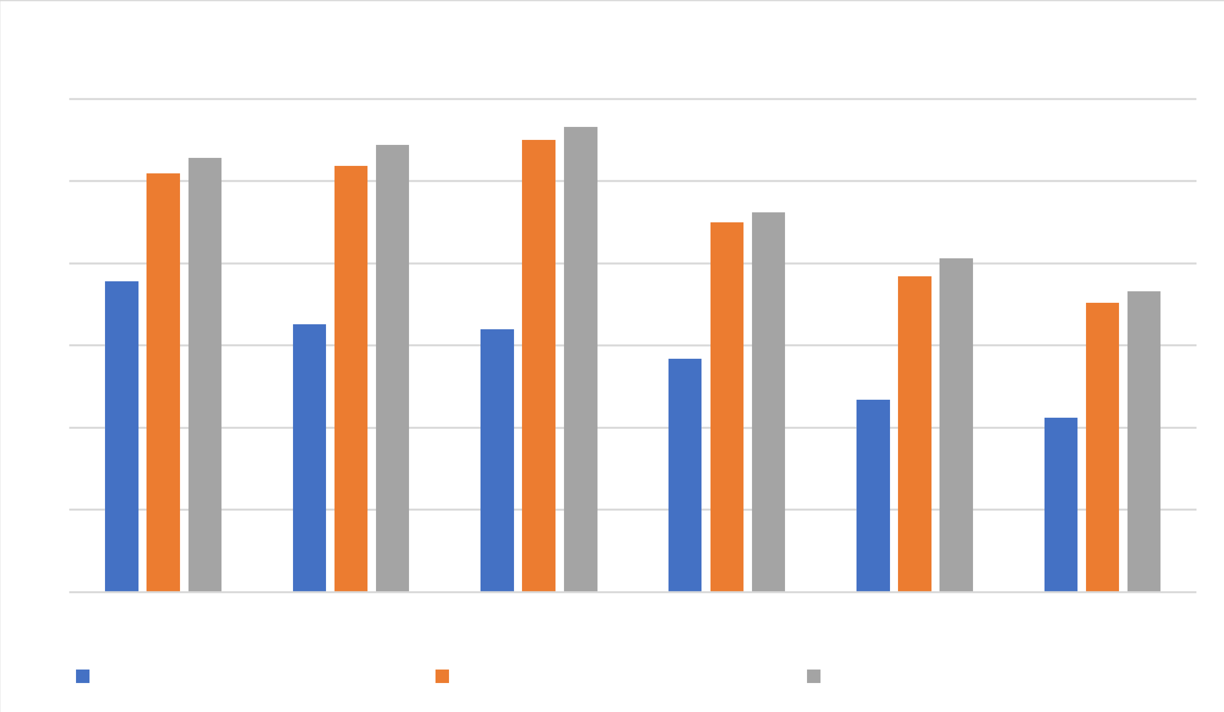

Figure4.2SplitTensileStrengthgraphvsage

Table.No: 4.3 90 Days average Flexural strength results for M30 grade

S.NO	MIX ID	Flexural Strength (N/mm^2)		
		7 Days	**28Days**	**90Days**
1	NORMALMIX	4.67	5.87	6.25
2	SCBA5%	4.53	6.13	6.52
3	SCBA10%	4.53	6.43	6.92
4	SCBA15%	3.33	5.75	5.85
5	SCBA20%	3.20	4.93	5.22
6	SCBA25%	3.07	4.13	4.66

5. Conclusions

Based on the study, following conclusions can draw.

i.There is a change in slump for SCBA 5% has decreased 3.5% when compared with normal mix.

ii.The slump for SCBA 10%, SCBA 15%, SCBA 20% and SCBA 25% has reduced by 4.7%, 8.2%, 14% and 18.7% respectively when compared with the normal mix.

iii.The compressive strengths of SCBA mixes at the age of 7 days was gradually decreases its strength when compared with normal mix.

iv.It was observed that the compressive strength of SCBA 5% and SCBA 10% at the age of 28 days has reached its target mean strength; however, the compressive strength was increased by 2.04% and 6.55% when compared with normal mix.

v.It was observed that the compressive strength of SCBA 15%, SCBA 20% and SCBA 25% at the age of 28 days has decreases its compressive strength by 6.15%, 16.92% and34.13% respectively when compared with the normal mix.

vi.The split tensile strength of mixes SCBA 5% and SCBA 10% at the age of 28 days has increases its strengths by 4.42% and 9.5% respectively when compared with the normal mix.

vii.The split tensile strength of mix SCBA 15%, SCBA 20%, SCBA 25% at the age of 28 days has decreases it strengths by 11.8%, 24.8% and 32.7% when compared with the normal mix.

viii.The flexural strength of SCBA 5%, SCBA 10% at the age of 28 days has increases its strength by 4.42%, 9.5% when compared with the normal mix.

ix.Cement can be replaced with bagasse ash up to 10% without much loss in compressive strength.

x.Considerable decrease in compressive strength was observed from 15% cement replacement. It has been shown in this study that 10% sugarcane bagasse ash can be used as a partial cement replacement material with technical and environmentalbenefits. Concerned stakeholder, such as sugar industries, cement industries and relevant government institutions, should be made aware about this potential cement replacement material and promote.

REFERENCES

1.Strength Properties of Concrete Using Crumb Rubber with Partial Replacement of Fine Aggregate S.Selvakumar, R.Venkatakrishnaiah, International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 3, March 2015.

2.Assessment of mechanical and durability properties of concrete containing waste rubber tire as fine aggregate, Trilok Gupta, Sandeep Chaudhary, Ravi K. Sharma Elsevier Construction and Building Materials.

3.Effect on Mechanical Properties of Rubberized Concrete due to Pretreatment of Waste Tire Rubber with NaOH, Qingwen Ma, Jinchao Yue, School of Water Conservancy and Environment engineering, Zhengzhou University, Zhengzhou 450002, China.

4.Finite Element Modeling of Compressive and Splitting Tensile Behavior of Plain Concrete and Steel Fiber Reinforced Concrete Cylinder Specimens Md. Arman Chowdhury, Md. Mashfiqul Islam, and Zubayer Ibna Zahid, Hindawi Publishing Corporation, Advances in Civil Engineering Volume 2016, Article ID 6579434.

5. Early-Age Thermal Cracking in Concrete, A FE-Modelling Approach, Master's Thesis in the Master's Program in Structural Engineering and Building Technology FRANCISCO DIAZ, RIKARD JOHANSSON

6.Behavior of concrete by partial replacement of coarse aggregate with recycled plastic granules, Visvesvaraya technological university belagavi, karnataka-590018